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Western larch sawfly in western Montana & north Idaho: 2017 Detection and Literature Review

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Western Larch Sawfly

Western larch is the principle host of western larch sawfly (WLS) (*Anoplonyx occidens* Ross) (figure 1). Potential secondary hosts include Engelmann spruce, lodgepole pine, and western white pine in Montana and north Idaho; and tamarack, black spruce and white spruce in other regions. Its range is restricted by the location of its host, generally from British Columbia south into Montana, north Idaho and Washington (Natural Resources Canada 2015).

Larvae in this genus are similarly shaped with a round head and an abdomen tapering toward the back. The 10-21 mm long larvae have fleshy abdominal legs (prolegs) on abdominal segments 2-7 and rudimentary legs on segment 8, which helps differentiate them from caterpillars of moths and butterflies, most of which do not have more than 5-pairs of prolegs (figure 2) (Natural Resources Canada 2015; Wong 1995; Borrer et al. 1989).

Figure 1. Larvae of western larch sawfly, *Anoplonyx occidens* Ross. (Photos: B. Steed, USDA Forest Service)

Western larch sawfly overwinters as a prepupal larva in a cocoon buried in the soil. In late-May to June, adults emerge and females lay eggs, usually singly, in needles. Larvae are present from mid-June to July with mature larvae dropping to the ground and spinning cocoons from late-July to August (Natural Resources Canada 2015). It is likely to have only one generation per year, although two generations has been suggested (USFS 1958).

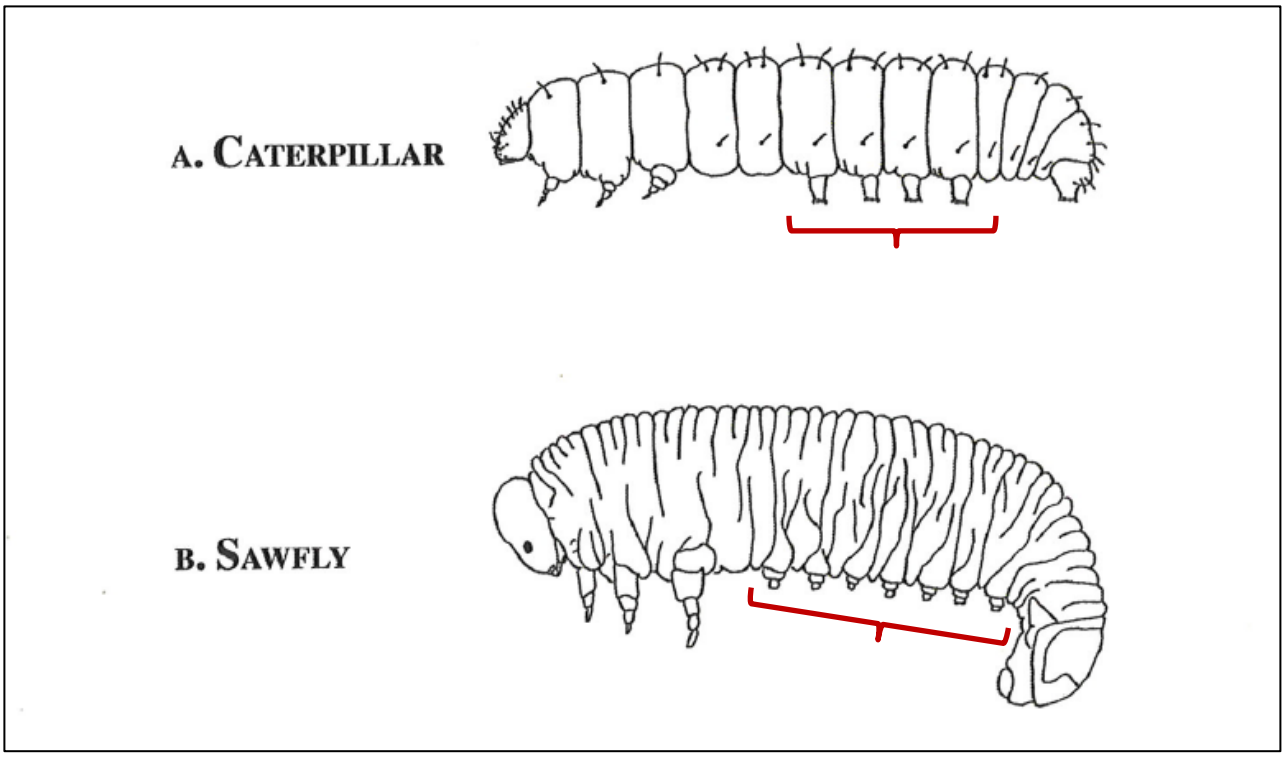

Figure 2. A: caterpillar of a moth or butterfly with 4 abdominal prolegs; B: caterpillar of a sawfly with 7 abdominal prolegs. Prolegs are indicated by red brackets.

Diagram from Hagel and others (2003)

Similar Sawfly Species

There are two additional species of sawfly recorded as feeding in western larch. **Larch sawfly** (*Pristiphora erichsonii* [Hartig]) has a lighter body and black head and was introduced in the late 1800's to North America from Europe. **Twolined larch sawfly** (*A. laricivorus* [Rohwer et Middleton]) has a brighter green body than WLS, with a similar tan head (Natural Resources Canada 2015) (figure 3). The **threelined larch sawfly** (*A. luteipes* [Cresson]) and the **onelined larch sawfly** (*A. canadensis* Hgtn.) feed on tamarack in northern and northeastern North America and are not found in the West (Natural Resources Canada 2015).

Figure 3. Larvae of larch sawfly, *Pristiphora erichsonii*, has a black head and lighter gray-green body (left), while the twolined larch sawfly, *Anoplonyx occidens*, has a tan head like WLS, but has a brighter green body (right).

Photos: James B. Hanson, USDA Forest Service, Bugwood.org and Natural Resources Canada, Canadian Forest Service, respectively.

Note that the common names used in this report are in accordance with those consistently used in Canada. In the United States, the common name "twolined larch sawfly" has been used in some instances instead of "western larch sawfly" for *A. occidens*, while the common name "western larch sawfly" sometimes referenced, *A. laricivorus* (Cram et al. 2012; Cordell et al. 1989; Schmidt et al. 1976; USFS 1958; USFS 1959). Some United States sources do follow the same naming conventions found in Canada (Boe 1958; Burns and Honkala 1990). Some confusion in common names may be due, in part, to the erroneous association between larvae and adult of *A. occidens* and *A. laricivorus* given by Keen in 1938 (see Wong 1955). In the United States there are currently no formally approved common names for any *Anoplonyx* species (ESA 2017). In Canada, the only currently approved names are for *A. luteipes* and *A.canadesis* as given above (ESC 2017).

Other Agents Damaging Larch Needles

In addition to the two other sawflies mentioned above, there are a number of caterpillar defoliators known to cause occasional damage to western larch in the Northern Region. The two that are the best known and most common are **larch casebearer** (*Coleophora laricella* [Hubner]) and **western spruce budworm** (*Choristoneura freemani* Razowski [=*C. occidentalis* Freeman]) (Scher 2002; Schmidt et al. 1976). Larch casebearer is a non-native insect first found in 1957 near St. Maries, Idaho. The small moth larvae are often visible upon close inspection, and the needles tend to be broken off or hollowed rather than looking chewed (figure 4). Larvae are inside the "case" made from needles hollowed out as they feed.

Feeding by western spruce budworm sometimes causes significant impacts when populations are high and western larch is found growing in stands of its preferred hosts of Engelmann spruce, subalpine fir, grand fir, and Douglas-fir (Fellin and Schmidt 1973). Damage (figure 4) often includes webbing, as well as significant defoliation of Douglas-fir, true firs, and spruce in the immediate vicinity of western larch.

Figure 4. Examples of larch casebearer (*Coleophora laricella*) (top) showing the small larvae within the needle and resulting straw collored, hollow needles (left) and defoliation with LCB cases on needles; and western spruce budbworm (*Choristoneura freemani*) larvar (bottom left) with pupa, webbing and partially eaten needles (bottom right)

Photos: Natural Resources Canada, Canada Forest Service; Petr Kapitola, Central Institute for Supervising and Testing in Agriculture, Forestry Images; Scott Tunnock, USDA Forest Service, Bugwood.org; Mike Johnson, Washington DNR

Several less common defoliators have also been noted feeding on western larch. The **larch needleworm moth** (or larch budworm), *Zeiraphera improbana* [Walker], is a tortricid caterpillar that can cause heavy but sporadic damage to western larch. **Larch looper** or green larch looper (also six-spotted angle moth), (*Macaria* [=*Semiothisa*] *sexmaculata* Packard, subspecies *incolorata*), is an inchworm caterpillar that has been found in western larch stands through western Montana, northern Idaho, and northeastern Washington (Schmidt et al. 1976; USFS 1958). Many other species are noted from eastern larch. These include a variety of *Macaria* loopers such as *M. sexmaculata* Packard, *M. signaria dispuncta* Walker (North American subspecies), and *M. oweni* Swett (Bergeron and Buckner 1974; Schmidt et al 1976), and **false hemlock looper** (*Nepytia canosaria* [Walker]) found from northeast Alberta, east and south through eastern US (Burns and Honkala 1990). In addition to *M. sexmaculata*, *M. signaria dispuncta* (**spruce-fir looper** or pale-marked angle moth) may also extend into our Region (Moth Photographers Group 2018). **Larch bud moth** (*Zeiraphera griseana* [Hüber]) has been reported as a defoliator of western larch (Schmidt et al. 1976), but is only listed currently as a European species.

Larch needle diseases are perhaps the most common cause of defoliation in western larch in the Northern Region. **Larch needle cast** (*Meria laricis* Vuillemin) and/or **larch needle blight** (*Hypodermella laricis* Tub.) kill infected needles, resulting in growth loss during severe infections. High moisture levels caused by frequent spring rains can stimulate high infection levels of these diseases. Needles infected with needle cast have discolored spots or bands thatare often shed within a few weeks of infection (figure 5, top). Needle blight kills all needles on a shoot and dead needles remain attached to the spur shoots for 1-3 years; infected needles turn red-brown and droop in the first year (figure 5, bottom).

Figure 5. Examples of larch needle cast (*Meria laricis*) (top) showing typical red banding on needles that are shed from the branch, and larch needle blight (*Hypodermella laricis*) (bottom) where all the needles on a spur shoot fade about the same time and old needles stay attached to the branch up to a year or more after death.

(Photos (top left to right, bottom left to right): Kenneth E. Gibson, USDA Forest Service, Bugwood.org; John W. Schwandt, USDA Forest Service, Bugwood.org; USDA Forest Service, USDA Forest Service, Bugwood.org; USDA Forest Service, Northern and Intermountain Region, USDA Forest Service, Bugwood.org)

Western Larch Sawfly Damage – Aerial Detection

Aerial detection survey (ADS) maps for 2017 show polygons of larch defoliation, most attributed to larch needle cast and/or larch needle blight. Given the wet spring of 2017, and past history of infections in the moist forests of northwest Montana and north Idaho, these observations were not unusual. FHP specialists were able to ground check an area delineated as larch needle disease along the Vermillion River corridor northeast of Trout Creek, Montana (Cabinet Ranger District, Kootenai National Forest) and confirm that the damage was caused by WLS (Steed and Jackson 2017). This finding spurred additional field recognizance of ADS polygons labeled as larch needle disease.

Ground surveys were conducted August 9th, 2017 (Vermillion area, Montana; 4th of July Pass, Idaho), August 10 (Coeur d'Alene River Ranger District, Idaho), August 24 (Magee to Wolf Lodge, Idaho), August 30 (Priest Lake, Idaho), and September 13 (DeBorgia/Haugan area, Montana) (figure 7 and Appendix A). Most locations were confirmed to be needle disease except for Magee, Vermillion area, and DeBorgia/Haugan that had defoliation by WLS. Appendix A shows locations of confirmed WLS sightings in more detail.

Western Larch Sawfly Damage – Ground Observations

Western larch sawflies chew on needles, leaving behind the needle rib early in the season, but consuming most of the needle as they mature and grow larger. Remaining needles have many chunks of different lengths removed (figure 6). From the ground this appears as yellow or red discoloration throughout much of the tree, although early in the season the tops appeared greener (figure 8, top; figure 9, right). This coloration is more apparent later in the season when the majority of feeding has been completed and needle fragments are dying (figure 8, bottom). When the early season ADS flight was conducted, many tree tops appeared green and damage looked very similar to needle disease (figure 9).

Figure 6. Examples of defoliation by western larch sawfly.

Photos: Brytten Steed (left); Sandy Kegley, (right).

Western Larch Sawfly Damage – Historical Impacts and Management Implications

Western larch sawfly is not known to cause significant tree damage or occur in large outbreaks. In Canada, WLS has been found in areas where no defoliation was evident (Erickson and Wood 1979). The only outbreak of significance recorded in the literature was of WLS and *A. laricivorus* working together to defoliate stands in northern Idaho and western Montana in 1921. By 1922 populations had practically disappeared (Furniss and Carolin 1977).

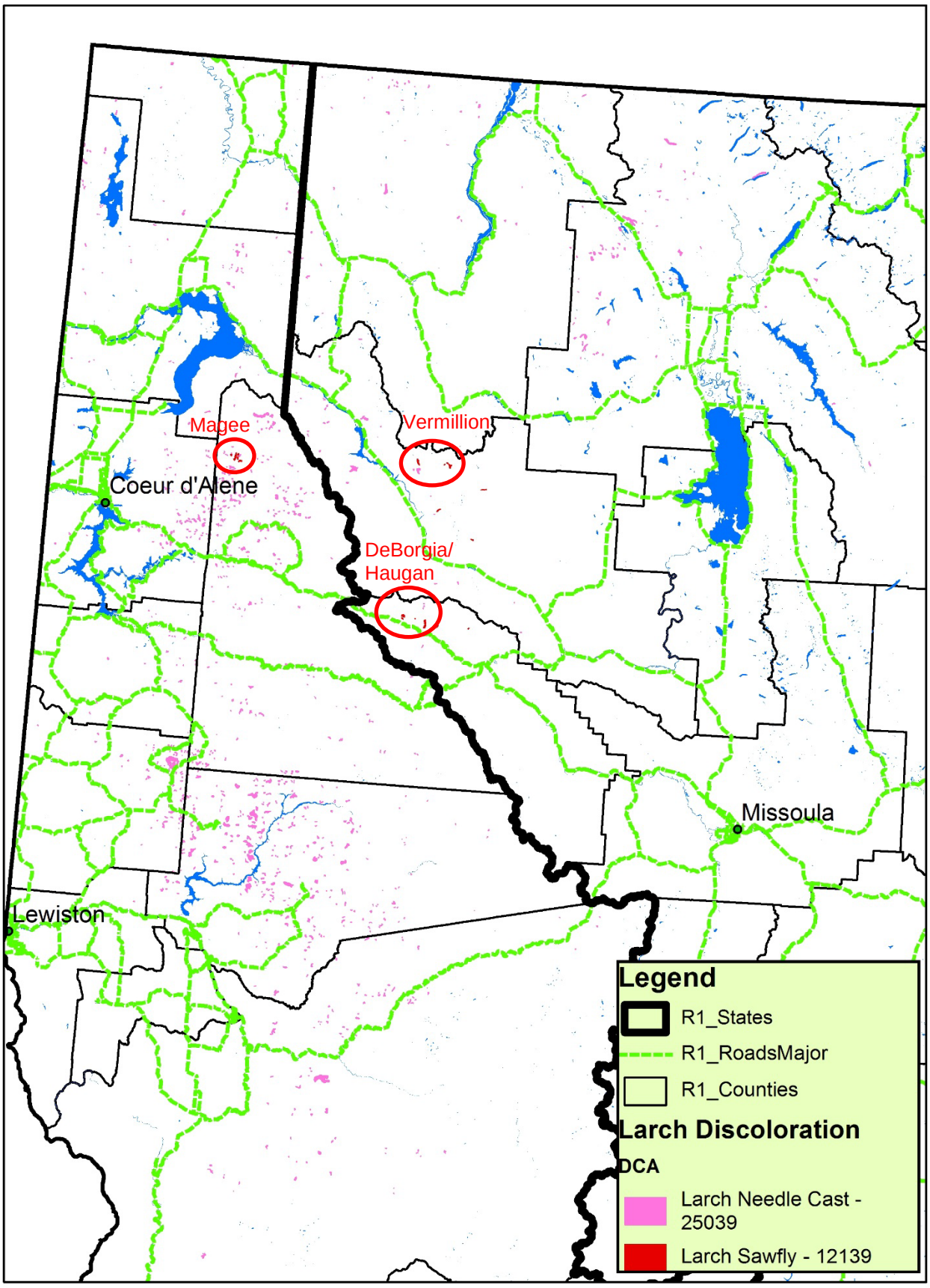

Figure 7. Locations of larch discoloration as delineated in the summer 2017 aerial detection survey. Discoloration is generally assumed to be needle disease. The three areas where field visits confirmed WLS (red circles) were changed in the survey to reflect this insect agent. Several but not all areas of discoloration were ground checked to determine causal agent. Those not checked remain identified as larch needle cast disease.

Figure 8. Top: Defoliation by western larch sawfly throughout the canopy, except for the very tops that appear green. B) Bottom: On the landscape, the fading of chewed needles become more apparent later in the season as larvae reach peak size and feeding capacity. (Photos: B. Steed)

Figure 9. Two types of larch needle discoloration detected by ADS and observed from the ground. Left: larch needle blight (*Hypodermella laricis*) near Priest Lake, ID; right: defoliation by larch sawflies (*Anoplonyx occidens)* near DeBorgia, MT. These can be difficult to discern from the air.

Defoliation can cause decreased growth. However, it is thought that most larch are fairly tolerant of short lived defoliation and may recover within the same summer. Severe defoliation over several years may weaken trees, causing them to be less likely to survive harsh winters (Furniss and Carolin 1977) or become more susceptible to other damage agents (Scher 2002).

Variability in defoliation levels due to differences in tree genetics have not been studied for western larch sawfly, but do exist for western larch needle diseases (Rehfeldt 1992) and are known to exist for other insect defoliators such as western spruce budworm (Chen et al. 2001; Clancy et al. 2004). The role of predators, parasites, competition with other defoliators, and weather events is not evident in the literature, but these factors likely play a role in population control, as they do with many other defoliators (Denton 1979; Sanders et al. 1985).

Historically, other insect defoliators were more active and had greater impacts on western larch in the Northern Region than WLS, although some of these defoliators were found in conjunction with WLS (table 1).

Table 1. Historical defoliation events of western larch sawfly (WLS) and similar species.

APPROXIMATE DATE	LOCATION	SAWFLY SPECIES	DESCRIPTION & OTHER LARCH DEFOLIATORS
1921 (Furniss and Carolin 1977)	western MT, north ID	*Anoplonyx occidens* (WLS), *A. laricivorus* (twolined larch sawfly)	the only outbreak of significance recorded; by 1922 populations had practically disappeared
prior to 1958 (USFS 1958)	western MT, north ID, northeast WA	*Anoplonyx occidens* (WLS), *A. laricivorus* (twolined larch sawfly)	notes WLS and *A. laricivorus* frequently found in association with larch looper in western larch stands
around 1958 (USFS 1958)	Missoula County, MT near the junction of the Clearwater and Blackfoot rivers	*Pristiphora erichsonii* (larch sawfly)	a localized outbreak of *P. erichsonii* was noted in sapling and pole sized western larch
1961-1966 (various USDA Forest Service Northern Region, Montana, and Idaho Forest Insect & Disease Conditions reports)	western MT, north ID	*Pristiphora erichsonii* (larch sawfly)	populations peaked in 1963, with about 25,000 acres of defoliation in 1964
1964-1967 (various USDA Forest Service Northern Region, Montana, and Idaho Forest Insect & Disease Conditions reports)	western MT	(n/a)	larch budmoth defoliation event with 518,000 acres affected in 1966
1963-1965 (various USDA Forest Service Northern Region, Montana, and Idaho Forest Insect & Disease Conditions reports)	western MT on the Lolo NF in the Swan River Valley and the Kootenai NF south of Libby	(n/a)	larch looper-caused defoliation
1977 (various USDA Forest Service Northern Region, Montana, and Idaho Forest Insect & Disease Conditions reports)	north ID	*Pristiphora erichsonii* (larch sawfly)	a complex of *P. erichsonii* and needle disease
1978-1979 (various USDA Forest Service Northern Region, Montana, and Idaho Forest Insect & Disease Conditions reports)	eastern WA	(n/a)	larch looper-caused defoliation
1983-1984 (various USDA Forest Service Northern Region, Montana, and Idaho Forest Insect & Disease Conditions reports)	north ID	*Pristiphora erichsonii* (larch sawfly)	a combination of *P. erichsonii* and larch casebearer
1985 (various USDA Forest Service Northern Region, Montana, and Idaho Forest Insect & Disease Conditions reports)	northwest MT	(n/a)	larch budmoth defoliation event with 152,000 acres affected
1990 (various USDA Forest Service Northern Region, Montana, and Idaho Forest Insect & Disease Conditions reports)	north ID	(n/a)	larch looper-caused defoliation
2004 (August) (personal communication from M. Jackson, FHP Plant Pathologist)	western MT on the Lolo NF up Gold Creek on the Blackfoot River	*Pristiphora erichsonii* (larch sawfly)	detected but not necessarily an outbreak.

These reports of past western larch defoliation suggest that all three sawflies, as well as other caterpillar defoliators, are present in the Northern Region, often together, and continue to be sporadically active, making identification of species difficult without the insect in hand.

Larch casebearer, the most common and visible of the insect defoliators on western larch, was first recorded in North America in 1886 (CFS 2015) and in the Northern Region in 1957. It spread unchecked throughout larch forests in the Northern Region during the next several years (about 2 million acres infested in 1965). Some tree

mortality occurred, but the biggest impact was severe growth loss. In the 1960's, the future of managing western larch seemed uncertain and planting western larch was discontinued on some forests. However, weather events that caused severe droughts, outbreaks of larch needle diseases that depleted food for larch casebearer, and introduced parasites, especially *Agathis pumila* and *Chrysocharis laricinellae*, caused population declines (Denton 1979). These introduced parasites, native parasites and predators continue to regulate larch casebearer populations. Thus, current outbreaks are generally localized, sporadic, and of short duration.

Because of the sporadic nature of defoliator outbreaks affecting western larch, and the ability of defoliated larch to produce a second set of needles the same season, direct control of larch defoliators is seldom warranted.

References

Bergeron, J.M.; Buckner. 1974. Some aspects of the populations dynamics of *Semiothisa* species (Geometridae: Ennominae) in southern Manitoba larch bogs. Can. Entomol. 106: 957-968.

Boe, K.N. 1958. Silvics of western larch. Miscellaneous publication No. 16. Ogden, UT: U.S. Department of Agriculture, Intermountain Forest and Range Experiment Station, Division of Forest Insect Research. 17p. (*one of many volumes found in a scan of miscellaneous publications*

Borer, D.J.; Tripplehorn, C.A.; Johnson, N.F. 1989. An introduction to the study of insects – 6th edition. Saunders College Publishing, New York NY. 875 p.

Burns, R.M.; Honkala, B.H. tech. coords. 1990. Silvics of North America: 1. Conifers. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. vol.2, 877 p.

Canadian Forest Service (CFS). 2015-08-04 <last modified>. Trees, insects and diseases of Canada's forests (TIDCF)

Chen, Z., Kolb, T.E., Clancy, K.M. 2001. Mechanisms of Douglas-fir resistance to western spruce budworm defoliation: bud burst phenology, photosynthetic compensation and growth rate. Tree Physiology 2001 (16):1159-69.

Clancy, M.; Chen, Z.; Kolb, T.E. 2004. Foliar nutrients and induced susceptibility: genetic mechanisms of Douglas-fir resistance to western spruce budworm defoliation. Canadian Journal of Forest Research 34(4): 939-949.

Cordell, C.E.; Anderson, R.L.; Hoffard, W.H.; Landis, T.D.; Smith, R.S. Jr.; Toko, H.V. 1989. Forest Nursery Pests. USDA Forest Service, Agriculture Handbook No. 680. 184 pp.

Cram, M.M.; Frank, M.S.; Mallams, K.M. (technical coordinators). 2012. Forest Nursery Pests. USDA Forest Service, Agriculture Handbook No. 680, 201 pp. (*This is a revision of Forest Nursery Pests, Agriculture Handbook No. 680 issued in December 1989, available in pdf format on the Reforestation, Nurseries and Genetics Resources Web site .)*

Denton, R.E. 1979. Larch casebearer in western larch forests. USDA Forest Service, General Technical Report, INT-55, 62 p.

Entomological Society of America (ESA). 2017. Common Names Database. Accessed on internet 2017/9/19 at

Entomological Society of Canada (ESC). 2017. Common Names Database. Accessed on internet 2017/9/19 at

Erickson, R.D.; Wood, C.S., 1979. Annual district report: Forest insect and disease survey, British Columbia, 1978, Part V-Nelson Forest District. Victoria, British Columbia: Pacific Forest Research Center, Canadian Forest Service.

Fellin, David G.; Schmidt, Wyman C. 1973. How does western spruce budworm feeding affect western larch? Gen. Tech. Rep INT-GTR-7. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 25 p.

Furniss, R.L.; Carolin, V.M. 1977. Western forest insects. Misc. Publ. 1339: U.S. Department of Agriculture, Forest Service. 654 p.

Hagle, S.K. 2004. Management guide for larch needle blight. Disease and insect management guide: USDA Forest Service, Forest Health Protection, Northern and Intermountain Regions. 5 p.

Hagle, S.K.; Gibson, K.E.; and Tunnock, S. 2003. Field guide to diseases and insect pests of northern and central Rocky Mountain conifers. Report number R1-03-08. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Region, Forest Health Protection. 197 p.

Moth Photographers Group. <accessed 2/24/2018>. Digital guide to moth identification. Mississippi Entomological Museum, Mississippi State University.

Natural Resources Canada (NRC). 2015. Trees, insects and diseases of Canada's forests; Western larch sawfly. Last modified 2015/08/04; Accessed 2017/09/19 at Trees, insects and diseases of Canada's forests.

Rehfeldt, G. E. 1992. Breeding strategies for *Larix occidentalis*: adaptations to the biotic and abiotic environment in relation to improving growth. Canadian Journal of Forest Research 22(1): 5-13.

Sanders, C.J.; Stark, R.W.; Mullins, E.J.; Murphy, J., editors. 1985. Recent Advances in Spruce Budworm Research, Proceedings of the CANUSA Spruce Budworms Research Symposium, Bangor, Maine, 1984. 527 p.

Scher, J.S. 2002. *Larix occidentalis*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: Larix occidentalis [2018, February 24].

Steed, B.; Jackson, M. 2017. Insect and disease concerns in the Vermillion project area, Cabinet Ranger District, Kootenai NF, 2017. MFO-TR-17-16. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Region, Forest Health Protection.

Schmidt, W.C.; Shearer, R.C.; Roe, A.L., 1976. Ecology and silviculture of western larch forests. Miscellaneous publication No. 1520. US Department of Agriculture, Forest Service.

Tunnock, S.; Ryan, R.B. 1985. Larch casebearer in western larch. USDA Forest Service, Forest Insect & Disease Leaflet 96. 8 p.

Unites States Forest Service (USFS). 1958. Forest Insect Conditions in the Intermountain and Northern Rocky Mountain States during 1957. Misc. Pub. No. 13. Ogden, UT: U.S. Department of Agriculture, Intermountain Forest and Range Experiment Station, Division of Forest Insect Research. 11p. (*one of many volumes found in a scan of miscellaneous publications)*

Unites States Forest Service (USFS). 1959. Forest Insect Conditions in the Intermountain and Northern Rocky Mountain States during 1958. Misc. Pub. No. 18. Ogden, UT: U.S. Department of Agriculture, Intermountain Forest and Range Experiment Station, Division of Forest Insect Research. 12p.

Unites States Forest Service (USFS). <various 1975-1987>. Idaho Forest Pest Conditions & Program Summary reports. Idaho Department of Lands and USDA Forest Service, Northern and Intermountain Regions. Reports located in Coeur d'Alene, ID. <various page lengths>

Unites States Forest Service (USFS). <various 1962-1974>. Forest Insect and Disease Conditions in the Northern Region reports. USDA Forest Service, Division of State and Private Forestry, Missoula, MT. Reports located in Coeur d'Alene, ID. <various page lengths>

Wong, H.R. 1955. Larvae of the Nearctic species of *Anoplonyx* (Tenthredinidae, Hymenoptera). The Canadian Entomologist 87: 224-227.

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Appendix A: More detailed maps of the locations of confirmed western larch sawfly sightings

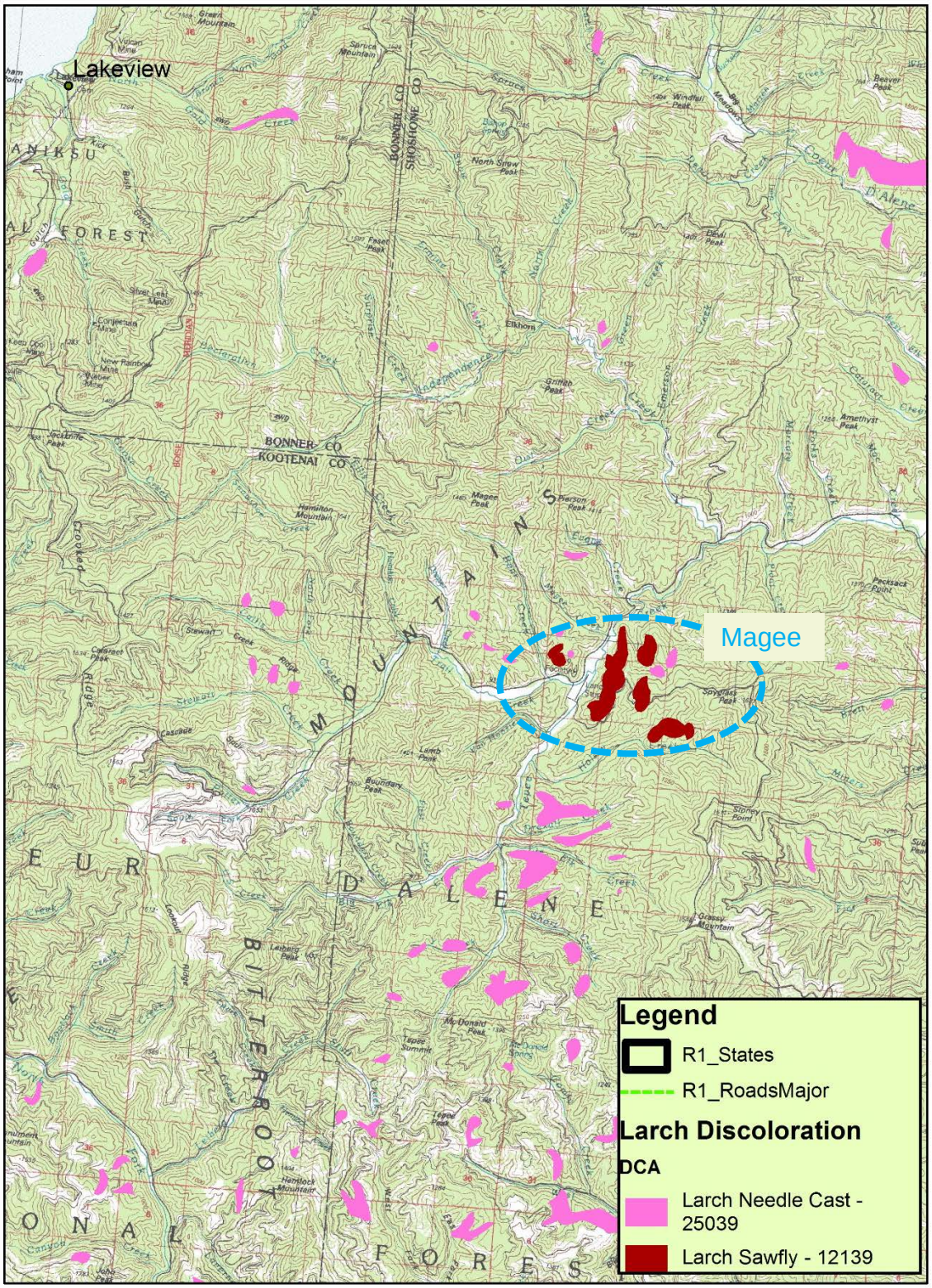

Figure A-1: Polygons in the Magee area assigned as larch needle cast during aerial detection survey, then confirmed as damaged by WLS during ground surveys.

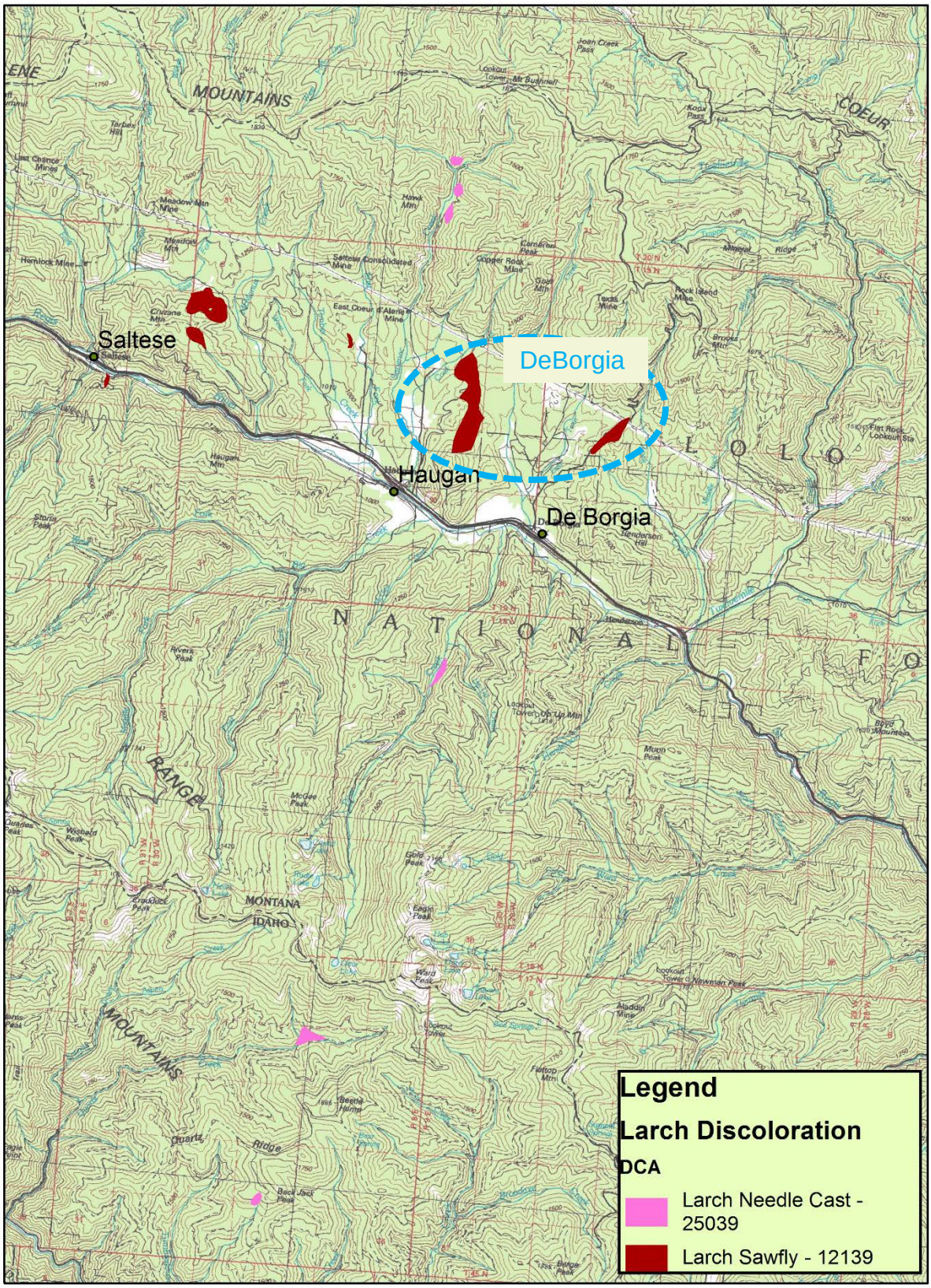

Figure A-2. Polygons in the De Borgia / Haugan area assigned as larch needle cast during aerial detection survey, then confirmed as damaged by WLS during ground surveys.

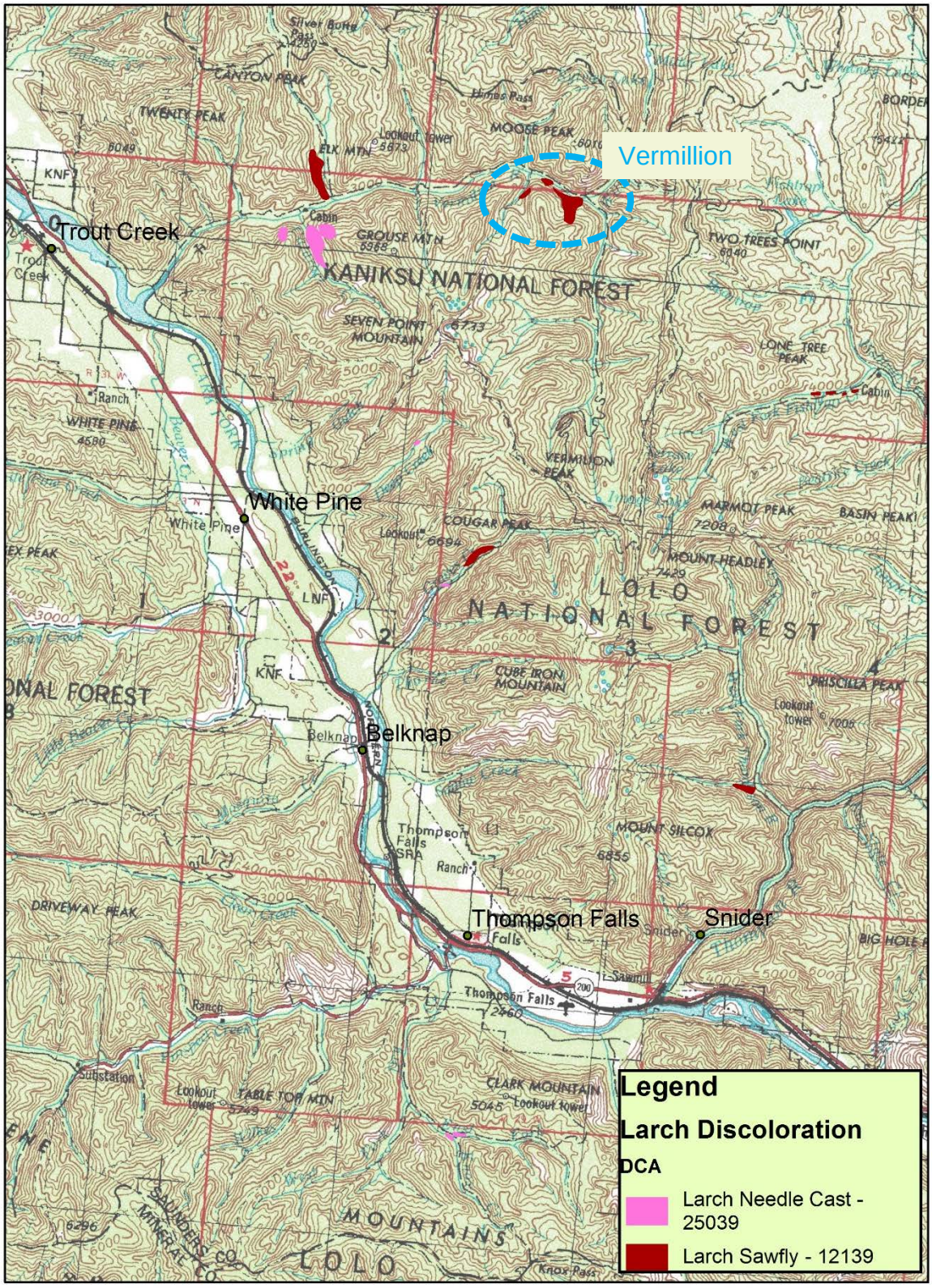

Figure A-3. Polygons in the Vermillion area assigned as larch needle cast during aerial detection survey, then confirmed as damaged by WLS during ground surveys.